

## PATENT ABSTRACTS OF JAPAN

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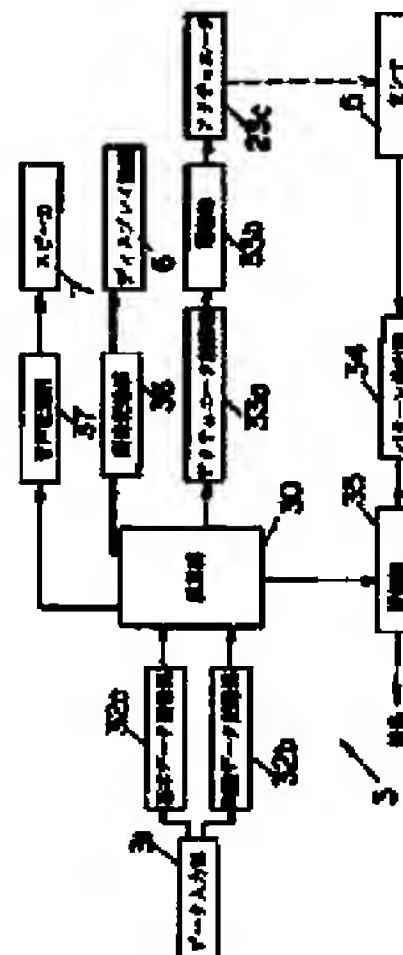
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(54) METHOD AND DEVICE FOR JUDGING ABILITY TO BALANCE

(57) Abstract:

**PROBLEM TO BE SOLVED:** To evaluate the ability to balance.

**SOLUTION:** A pedestal on which a person stands is oscillated by an actuator 23c, and by appropriately using control data stored in a stimulation data memory part 32b, such oscillation that the user has not expected is applied to the pedestal. His/her movement at the time is detected by a sensor 5, and his/her ability to balance is judged based on the pattern of his/her reaction detected by the sensor 5 after the simulation is applied to the him/her.



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## CLAIMS

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[Claim(s)]

[Claim 1]A capacity- of- balance judging method judging capacity of balance based on a reaction pattern which detected people's reaction to this stimulus, and was detected after giving a stimulus while giving a stimulus which loses balance of those who have ridden on a plinth by which swinging and driving is carried out to timing which is not predicted by people.

[Claim 2]A capacity- of- balance judging method according to claim 1, wherein said stimulus is given by changing rocking of a plinth.

[Claim 3]A capacity- of- balance judging method according to claim 1, wherein said stimulus is given by directing operation to people.

[Claim 4]Time until it operates so that said reaction pattern may maintain balance after giving a stimulus, A capacity- of- balance judging method according to any one of claims 1 to 3 being at least 1 element of movement magnitude when time and a stimulus which have lost balance after giving a stimulus are given, and time to a grade and a reaction of a stimulus.

[Claim 5]A capacity- of- balance determining device comprising:

A plinth on which people ride.

A driving means which carries out swinging and driving of the plinth.

A stimulation means which gives a stimulus which loses balance of those who have ridden on a plinth to timing which is not predicted by people.

A judging means which judges capacity of balance based on a sensor which detects people's reaction to this stimulus, and a reaction pattern detected by a sensor after giving a stimulus by a stimulation means.

[Claim 6]The capacity- of- balance determining device according to claim 5 detecting a motion of people's desired region from a temporal change of a picture which picturized those who said sensor was formed apart from a plinth and have ridden on a plinth by non- contact.

[Claim 7]The capacity- of- balance determining device according to claim 6 said judging means's asking for a period when amplitude of a motion of a desired region detected by said sensor exceeds a regular threshold, and judging with capacity of balance being high, so that this period is short.

[Claim 8]The capacity- of- balance determining device according to claim 6 said judging means's extracting a pattern within a short time about a motion of a desired region detected by said sensor, and judging with capacity of balance being high, so that there is little change of a pattern.

[Claim 9]The capacity- of- balance determining device according to claim 6 said judging means's searching for a time lag with a motion of a plinth about a motion of a desired region detected by said sensor, and judging with capacity of balance being high, so that this time lag is small.

[Claim 10]A capacity- of- balance determining device judging capacity of balance combining plurality of the judging means used for the capacity- of- balance determining device according to any one of claims 7 to 9.

[Claim 11]The capacity- of- balance determining device according to claim 5, wherein said stimulation means gives directions to which rocking of a plinth is changed to a driving means.

[Claim 12]The capacity- of- balance determining device according to claim 5, wherein said stimulation means displays directions of operation into an image which is the display device formed independently and is displayed on a display device.

[Claim 13]The capacity- of- balance determining device according to claim 5, wherein said plinth is

provided with a grip part which people have by hand and said sensor detects at least 1 element of power when holding a grip part, power which pushes and lengthens a grip part, and people's centroid position.

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[Translation done.]

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DETAILED DESCRIPTION

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[Detailed Description of the Invention]

[0001]

[Field of the Invention]This invention relates to the capacity-of- balance judging method which enables objective evaluation of people's capacity of balance, and its device.

[0002]

[Description of the Prior Art]Before, the art of evaluating capacity of balance objective is proposed [ various ]. For example, while the movement formations of the center of gravity are detected while making the base plate in which people ride tilt to JP,S64- 52441,A by a motor, and detecting the pattern of damage about capacity of balance according to the movement formations, the device which chooses the program to which a base plate is made to tilt is indicated.

[0003]

[Problem(s) to be Solved by the Invention]By the way, a thing given in the above- mentioned gazette is trained so that the obstacle may be removed, and is not necessarily suitable as what evaluates the capacity of balance as a healthy person's athletic ability while it mainly detects the obstacle of capacity of balance. That is, since capacity of balance is judged in order that what was indicated in the above- mentioned composition may mainly judge the existence of an obstacle, it is difficult to evaluate the high level of capacity of balance.

[0004]Succeeding in this invention in view of the above- mentioned reason, the purpose is to provide the capacity-of- balance judging method of having enabled it to evaluate the high level of capacity of balance, and its device.

[0005]

[Means for Solving the Problem]While an invention of Claim 1 gives a stimulus which loses balance of those who have ridden on a plinth by which swinging and driving is carried out to timing which is not predicted by people, It is characterized by judging capacity of balance based on a reaction pattern which detected people's reaction to this stimulus, and was detected after giving a stimulus, After losing a grade and balance which lost balance since a stimulus which loses balance to timing which people do not predict was given, the high level of capacity of balance can be evaluated by detecting time until it returns to the state of maintaining balance etc.

[0006]In an invention of Claim 1, without said stimulus adding a special device by being characterized by being given by changing rocking of a plinth, an invention of Claim 2 only changes a rocking pattern of a plinth suitably, and can give a stimulus for evaluating capacity of balance.

[0007]Set an invention of Claim 3 to an invention of Claim 1. When said stimulus directs operation to people by being characterized by being given by directing operation to people, game nature can be given when judging capacity of balance, and capacity of balance can be judged, enjoying itself.

[0008]In an invention of Claim 1 thru/or Claim 3, an invention of Claim 4 said reaction pattern, Time which has lost balance after giving time until it operates so that balance may be maintained after giving a stimulus, and a stimulus, By being characterized by being at least 1 element of movement magnitude when a stimulus is given, and time to a grade and a reaction of a stimulus, if these information is used, capacity of balance can be evaluated easily.

[0009]A driving means to which an invention of Claim 5 carries out swinging and driving of a plinth on which people ride, and the plinth, A stimulation means which gives a stimulus which loses balance of those who have ridden on a plinth to timing which is not predicted by people, It is a thing provided with a sensor which detects people's reaction to this stimulus, and a judging means

which judges capacity of balance based on a reaction pattern detected by a sensor after giving a stimulus by a stimulation means, After losing a grade and balance which lost balance since a stimulus which loses balance to timing which people do not predict was given, the high level of capacity of balance can be evaluated by detecting time until it returns to the state of maintaining balance etc.

[0010]An invention of Claim 6 detects a motion of people's desired region from a temporal change of a picture for which said sensor pictured those who a plinth was provided independently and have ridden on a plinth by non-contact in an invention of Claim 5. According to this composition, since a sensor is formed apart from a plinth and a sensor detects a motion of people's desired region by non-contact, a motion of people can be detected, without making conscious of a sensor a person who got into [ a plinth ].

[0011]In an invention of Claim 6, said judging means asks for a period when amplitude of a motion of a desired region detected by said sensor exceeds a regular threshold, and an invention of Claim 7 judges with capacity of balance being high, so that this period is short. According to this composition, it becomes possible to evaluate capacity of balance by amplitude of a motion of people quantitatively and objective.

[0012]In an invention of Claim 6, said judging means extracts a pattern within a short time about a motion of a desired region detected by said sensor, and it judges with capacity of balance being high, so that an invention of Claim 8 has little change of a pattern. According to this composition, based on a pattern of a motion of people, capacity of balance can be evaluated objective.

[0013]In an invention of Claim 6, said judging means searches for a time lag with a motion of a plinth about a motion of a desired region detected by said sensor, and an invention of Claim 9 judges with capacity of balance being high, so that this time lag is small. According to this composition, capacity of balance can be evaluated based on a time lag of a motion of a plinth and a motion of people, and it can evaluate objective.

[0014]An invention of Claim 10 judges capacity of balance combining plurality of the judging means used for the capacity-of-balance determining device according to any one of claims 7 to 9. According to this composition, more exact evaluation about capacity of balance is attained by using two or more kinds of criteria.

[0015]In an invention of Claim 5, without said stimulation means's giving directions to which rocking of a plinth is changed to a driving means, and adding a special device, an invention of Claim 11 only changes a rocking pattern of a plinth suitably, and can give a stimulus for evaluating capacity of balance.

[0016]By said stimulation means's being the display device formed independently in an invention of Claim 5, and an invention of Claim 12 displaying directions of operation into an image displayed on a display device, and directing operation to people, Game nature can be given when judging capacity of balance, and capacity of balance can be judged, enjoying itself.

[0017]As for an invention of Claim 13, said plinth is provided with a grip part which people have by hand in an invention of Claim 5, If said sensor detects at least 1 element of power when holding a grip part, power which pushes and lengthens a grip part, and people's centroid position and uses these information, capacity of balance can be evaluated easily.

[0018]

[Embodiment of the Invention](Embodiment 1) This embodiment shows the example to which the plinth 1 of the shape of a seat in which people take a seat is moved with the drive (driving means) 2 which consists of parallel mechanisms, as shown in drawing 2, but it may be made to ride in the form over the plinth 1, for example using the plinth 1 of the saddle shape of a horse. Motion control of the drive 2 is performed by the control device 3 mentioned later. The handle 4 which people operate is formed in the plinth 1, and operation of the handle 4 is detected by the sensor 5. This sensor 5 can detect the movement magnitude of the handle 4, the load which acts on the handle 4, and the power which grasps the handle 4. The handle 4 is pivoted so that up-and-down motion at the rear of the plinth 1 may be attained, and it is constituted so that it may have the grip part provided in the front end part with both hands. The sensor 5 which detects the centroid position of the person who sat down is formed in the plinth 1.

[0019]The drive 2 is provided with the following.

Standing ways 21 fixed to the regular position as shown in drawing 3.

The movable base 22 supported above the standing ways 21 via the six legs 23.

Each leg 23 is combined via the universal joints 24a and 24b to the standing ways 21 and the movable base 22, respectively. The support pipe 23a which combined each leg 23 with the standing ways 21 via the universal joint 24a, It consists of the rod 23b which consists of a ball screw inserted into the support pipe 23a enabling a free attitude, and the actuator 23c which is provided with the gear which meshes to the rod 23b, and makes the rod 23b move with rotation of right reverse. The tip part of the rod 23b is combined with the movable base 22 via the universal joint 24b. Therefore, if the actuator 23c of each leg 23 is controlled, respectively and the amount of attitudes of the rod 23b is adjusted, the position of the movable base 22 to the standing ways 21 can be adjusted suitably.

[0020]The six legs 23 detach leg 23 comrades which are combined with the standing ways 21 as approached at a time in two, and are combined by approaching to the standing ways 21, and have combined them with the movable base 22. By such composition, control of 6 flexibility of the parallel translation of three directions which intersect perpendicularly mutually, and a rotation centering on an all directions-oriented axis is attained. That is, movement which combined right and left, up- and- down rectilinear- propagation reciprocation moving, and the rotation reciprocation moving around an antero- posterior axis, a lateral axis, and a normal axis is attained approximately, and the movable base 22 moves the plinth 1 combined with the movable base 22 as a result with 6 flexibility. The movable base 22 of the drive 2 will perform those compounded operations rather than the operation decomposed into above rectilinear- propagation movements and rotations actually.

[0021]In order to give the following explanation easy, the coordinate system centering on the plinth 1 is introduced. That is, an X axial direction and a longitudinal direction are made into Y shaft orientations, a sliding direction is made into Z shaft orientations for the cross direction of the plinth 1, and the rectangular coordinate system of a right- hand system which sets the starting point as the center of the standing ways 21 of the drive 2 is set up. A deer is carried out, and while the position of the three directions of an X axial direction, Y shaft orientations, and Z shaft orientations is variable, as for the movable base 22 of the drive 2, inclination of the circumference of each axis of the X- axis, a Y- axis, and the Z- axis becomes variable. Rotation of the circumference of a pitch and the Z- axis is called [ rotation of the circumference of the X- axis ] a yaw for rotation of the circumference of a roll and a Y- axis.

[0022]While arranging the display device 6 large- sized ahead of the plinth 1 in the example shown in drawing 2, Although the loudspeaker 7 is arranged on both sides of the display device 6, the image displayed on the display device 6 can be changed according to rocking of the plinth 1 or the sound according to the image can be made to output from the loudspeaker 7, In this embodiment, neither the display device 6 nor the loudspeaker 7 is necessarily required.

[0023]The control device 3 is constituted using computer paraphernalia, controls the drive 2 as mentioned above, and also it is controlled about the sound outputted from the picture displayed on the display device 6, or the loudspeaker 7. That is, the control device 3 has the composition shown in drawing 1, stores in the basic data storage parts store 32a and the stimulus data storage part 32b the control information inputted from the data input part 31, and drives the actuator 23c of the drive 2 using these data. The data input part 31 generates control information by analyzing a motion of the important section of the person in horse riding.

[0024]The basic data storage parts store 32a and the stimulus data storage part 32b consist of semiconductor memory, respectively, and the data which makes the drive 2 rock in the operation part 30 based on the control information stored in the basic data storage parts store 32a and the stimulus data storage part 32b is generated. From the operation part 30, the data equivalent to the length of each leg 23 of the drive 2 is outputted, in the actuator control parts 33a, the operation amount of the actuator 23c according to this data is decided, and the actuator 23c is driven via the actuator 33b. The actuator 33b controls the energization to the actuator 23c based on the operation amount decided by the actuator control parts 33a. That is, a control means is constituted by the operation part 30, the data storage part 31, the actuator control parts 33a, and the actuator 33b in this embodiment.

[0025]By the way, the control information stored in the basic data storage parts store 32a or the stimulus data storage part 32b, As shown in drawing 4, the position  $X_i$  of an X axial direction, Y shaft orientations, and Z shaft orientations,  $Y_i$ , and  $Z_i$  (i is a positive number), 6 groups with inclination (yaw, pitch, roll)  $\alpha_i$  of the circumference of the Z- axis, the circumference of a Y-



axis, and the circumference of the X-axis,  $\beta$ , and  $\gamma$  ( $i$  is a positive number) are set up with a certain time interval (drawing 4 (a) is the control information on the basic data storage parts store 32a, and drawing 4 (b) is the control information on the stimulus data storage part 32b). Control information is time series data and is set up from a series of rocking patterns. Such a series of vibration patterns are divided with a certain time interval short enough, and the above-mentioned 6 groups are set up for every pause. In short, the unit pattern is constituted by the time series data of 6 groups.

[0026] At the operation part 30, it is drawing 4 (a). Based on control information as shown in (b), the length of each leg 23 of the drive 2 in each time is determined. In this way, according to the length of the determined leg 23, the operation amount of the actuator 23c is decided by the actuator control parts 33a, and the actuator 23c is driven via the actuator 33b.

[0027] The point of changing the rocking pattern of the plinth 1 to the timing which people cannot predict by this embodiment here has the feature, The control information stored in the basic data storage parts store 32a is always repeated and used, the drive 2 is controlled, the control information stored in the stimulus data storage part 32b to proper timing is piled up, and the drive 2 is controlled. That is, although the control information stored in the basic data storage parts store 32a has periodicity, rocking which deviated from periodicity can be given by using the control information stored in the stimulus data storage part 32b. There is less number of 6 groups of the control information stored in the stimulus data storage part 32b than the number of 6 groups of the control information stored in the basic data storage parts store 32a. Now and drawing 4 (a) As that in which the control information on (b) is stored, if time  $T_{11}$ - $T_{1n}$  6 groups are piled up, data will be generated like drawing 4 (c). In time  $T_{11}$ - $T_{1n}$  six each group, it is drawing 4 (a) here. The value which added 6 groups of the time in (b), respectively is used. For example, the value  $X_{21}$  of the time  $T_{11}$  in drawing 4 (c) is  $X_{21}=X_{01}+X_{11}$ , and other values are the same.

[0028] If rocking which people do not predict to rocking of the plinth 1 as mentioned above is added, though balance can be maintained by a habituation only by the control information stored in the basic data storage parts store 32a, Since balance is lost when the control information stored in the stimulus data storage part 32b is given, move the handle 4, it grasps strongly, or different centroid movement from always on the plinth 1 arises. Since these information is detectable by the sensor 5, the change pattern of the output of the sensor 5, That is, the grade of capacity of balance can be known by detecting the reaction pattern about the reaction of a person when the plinth 1 is driven using the control information on the stimulus data storage part 32b in the pattern detection part 34, and evaluating a reaction pattern in the evaluating part 35. In short, a stimulation means is constituted by the stimulus data storage part 32b and the operation part 30.

[0029] The pattern detection part 34 detects the size and speed of change of an output of the sensor 5, For example, time which is lengthening the handle 4 (or it is pushing), time in which the center of gravity was carrying out specified quantity movement, After using the control information on the stimulus data storage part 32b, it asks for temporal changes, such as power applied to time until a change characteristic of the power which grasps the position of the handle 4 and the handle 4 arises, and the handle 4, as a reaction pattern. Using these information, by the evaluating part 35 as a judging means, statistical processing are, carry out and according to fuzzy logic is performed, and the index of capacity of balance is evaluated. In order to obtain the index of capacity of balance here, it measures about a lot of people, and a statistical procedure, such as calculating the average value of a measurement result, is performed.

[0030] Now, the number of times which applies the power beyond a predetermined value to the handle 4 (it is lengthened whether it pushes) shall be used as an index of capacity of balance into fixed time. As shown in drawing 5, after starting drive change by beginning to give the control information stored in the stimulus data storage part 32b (S1), it is judged whether the power beyond a predetermined value acted on the handle 4 (S2). Here, the minus points system can estimate capacity of balance from the upper limit of mark, using [ then ] mark as an index of capacity of balance. For example, since it is thought that balance was lost when the power beyond a predetermined value acts, a demerit mark is given (S3), and when the drive by the control information stored in the stimulus data storage part 32b is completed, evaluation of (S4) and capacity of balance is ended (S5). For example, as shown in drawing 6 (a), it judges whether the power beyond a predetermined value acts on the handle 4, and the time of and not acting is set to OFF. [ the time of power acting ] If the procedure of drawing 5 estimates, mark fall, so that there

is much number of times of one like drawing 6 (b), and capacity of balance can be index-ized. [0031]What is necessary is to be able to use the thing of a horse form as the plinth 1 as mentioned above, to replace with the handle 4 in this case, and just to provide reins. What is necessary is just to make it always repeat this using a series of patterns corresponding to a footpace, quick time, gallop, etc. as control information stored in the basic data storage parts store 32a, so that the gait of a horse may be imitated. Here, by the footpace W1 and the quick time W2, as shown in drawing 7, since a pattern changes a lot, when changing a pattern in consideration of safety, bond pattern W3 is inserted in between. Thus, a pattern can be changed smoothly.

[0032]The picture displayed on the display device 6, What is necessary is just to control the sound which should just control to store in the image storage section 36 and to be interlocked with the drive of the plinth 1 by the operation part 30, and is outputted from the loudspeaker 7 to store in the phonetic memory part 37 and to suit a screen display of the display device 6 by the operation part 30. The picture displayed on the display device 6 uses an on-the-spot photo or computer graphics. An on-the-spot photo image uses what was photoed by subjectivity movement. Since large scale is required for the image storage section 36 or the phonetic memory part 37, it is desirable to use the memory storage which uses a magnetic disk, an optical disc, a magneto-optical disc, etc. as a recording medium. If the recording medium is especially made exchangeable, the contents of the sound outputted from the display information and the loudspeaker 7 of the display device 6 can be changed easily, and monotony can be eased.

[0033](Embodiment 2) In Embodiment 1, in order that the display device 6 may ease monotony, only use, but. It enables it to measure the grade of capacity of balance at this embodiment by demanding a certain operation from people and making it correspond to the operation on the plinth 1 under rocking according to the display information of the display device 6. That is, the rule of how the people operate to the display information is decided using the display device 6 as a stimulation means, and it is going to measure the grade of capacity of balance by the ability of people to perform operation according to a rule. It becomes possible to carry out being able to give game nature and enjoying measurement of capacity of balance by this method.

[0034]In this embodiment, in order to give people a stimulus with the display device 6, as shown in drawing 8, the inserting image storage parts store 38 and the superimpose processing part 39 are formed. The inserting image storage parts store 38 has memorized the picture suitably displayed in a screen, and lays it on top of the picture from the image storage section 36 through the superimpose processing part 39. For example, a rule is decided as operation over which it jumps is performed, it performs operation avoided if it is a poison apple and operation taken if it is an ordinary apple is performed, when a thing like [ in order to give game nature ] a hurdle, a poison apple, and an ordinary apple is displayed and a hurdle is displayed. Although these operations have a desirable thing accompanied by centroid movement here, since it is also difficult for the low person of capacity of balance to operate a button by a fingertip on the plinth 1 under rocking, it may not necessarily be operation accompanied by centroid movement. That is, a rule can be set up in consideration of the grade of each one of capacity of balance. In this embodiment, the stimulus data storage part 32b does not need to provide.

[0035]As a display which directs operation to a person besides the thing accompanied by this kind of superimposition, the way is displayed on the screen of the display device 6, branching and an inclination may be established in a way, and a rule may be decided to perform operation according to change of these ways by the handle 4. The rule is set as how to lengthen reins in imitating a horse especially, for example, if right-hand side is lengthened, it will turn to the right, if left-hand side is lengthened, it will turn to the left, and the rule of corresponding to an inclination by the strength of length is decided. Thus, the measurement procedure of the grade of the capacity of balance in the case of imitating a horse is shown in drawing 9.

[0036]The time which is lengthening reins in here in order to evaluate the measured value in the sensor 5 quantitatively, After giving the time and the stimulus in which the center of gravity was carrying out specified quantity movement, the temporal change of information, including the movement speed (this is because operation becomes difficult so that the movement speed of the plinth 1 is large) etc. of the drive 2 when the power and the stimulus which lengthened the reaction time in specified quantity \*\*\*\*\* and reins for reins are given, is used as a reaction pattern.

[0037]Now, supposing a certain directions are displayed on the display device 6 (S1), it will be



judged whether reins were lengthened first (S2) and it will be judged whether how to lengthen if it is lengthening is the right (S3). It will end, if a demerit mark is given and it completes (S4) and directions, in not being right (S5). If reins are not lengthened in Step S2 and directions moreover are not completed (S6), a demerit mark will be given (S7). Thus, if it indexes by the minus points system, capacity of balance can be evaluated objective. Other composition and operations are the same as that of Embodiment 1.

[0038](Embodiment 3) Although the sensor 5 which detects people's reaction is formed in the plinth 1 people get into [plinth] and he was trying for the sensor 5 to detect people's centroid position in the embodiment mentioned above, As shown in drawing 10, while using the two imaging devices 8 arranged on both sides of the display device 6, the sensor 5 consists of these embodiments using the image processing device (not shown) which acquires three-dimensional information using the azimuth difference of two pictures picturized with both the imaging devices 8. The TV camera is used for the imaging device 8. In an image processing device, the position of the pixel to the common object within two pictures is extracted, it is based on the physical relationship of both pixels, and the position of the subject in three-dimensional space is searched for. In an image processing device, the information about people is separated from a background by dividing into a position within a picture the part which change does not produce, and the part which a position change produces. Thus, it becomes possible to detect a motion of people continuously. And since the sensor 5 is formed independently [the plinth 1] and a motion of people can be detected by non-contact, it is not necessary to attach the sensor 5 to the plinth 1 or a person, and to attach a certain marker to people, and detection of a motion of people is attained, without making people conscious of the sensor 5. It can be arbitrarily directed in an image processing device a motion [which part of people] is detected here, for example, it can extract only a motion of a head and a shoulder.

[0039] When using the imaging device 8 and an image processing device as a sensor, capacity of balance can be judged using at least one element in the size of the extracted motion, stability, and a response.

[0040] The size of a motion means the head of the person at the time of making the plinth 1 rock, and the amplitude of a shake of a shoulder. Since the amplitude of the shake of a head or a shoulder to rocking of the plinth 1 is generally so small that capacity of balance is high, when the plinth 1 is driven according to the program which sets up the threshold to amplitude and was defined beforehand, If the period which exceeds a threshold in the driving period of the plinth 1 is measured, it can judge with capacity of balance being high, so that this period is short. The threshold over amplitude is determined experimentally, it collects two or more persons' data about amplitude actually, takes into consideration the capacity of balance of the person who became a collection object of data, and determines a threshold.

[0041] Drawing 11 - drawing 13 show the result of having measured the grade of the shake of the head of a person different, respectively using the above-mentioned sensor 5 about the case where imitated the setting stage of low height of the horse, and the plinth 1 is made to rock. The man to whom drawing 11 belongs to a horse-riding part at the age of 29, the man to whom drawing 12 does not have horse-riding experience at the age of 58, and drawing 13 are the results of measuring about the man who is inexperienced in horse riding at the age of 63. As for the data of \*\* in each figure, the shake of right and left (a top is the right) and the data of \*\* show shakes (a top. before) in front and behind. The number of pixels of the picture was 160 pixels about right and left, and was 120 pixels about order. The numerical value of the horizontal axis of each figure showed the frame number of the picture, and one frame could be 1 / 33 seconds. Each figure has shown the example which changed the amplitude which makes the plinth 1 rock to the three-stage, and right- and- left 3 division shows each amplitude with it. That is, a left division has the largest amplitude, and if this amplitude is made into the amplitude of 10, the central division has made the amplitude of 8, and a right division into the amplitude of 6. The pendant of the imaging device 8 was carried out here from the ceiling so that the influence of vibration of the plinth 1 might not be received.

[0042] In the example of drawing 11, the size of a shake of a head also changes according to the size of the amplitude of the plinth 1, and change of amplitude is stable and it can be said that there is no disorder in a rhythm so that it may turn out that each figure is compared. In the example of drawing 12, to change of the size of the amplitude of the plinth 1, although there is

little change of the size of a shake of a head, change of amplitude is stable, and a rhythm has little disorder. Although it is in the tendency for the size of a shake of a head to also change according to the size of the amplitude of the plinth 1, in the example of drawing 13, regardless of the amplitude of the plinth 1, the shake of a head may become large, change of amplitude is unstable and a rhythm has disorder. Although not expressed with the figure, a time delay (that is, response) after the plinth 1 rocks until a head shakes also changes with individuals.

[0043] Therefore, the size of a motion of people, stability, and a response can be used for the judgment of capacity of balance. Now, capacity of balance is judged using the size of a shake of people's head (a shoulder may be sufficient), then it becomes a procedure shown in drawing 14. That is, the threshold over the amplitude of a head is determined based on measured data file F1 which stored the pattern of rocking of the plinth 1, and the pattern of the shake of the head about two or more persons first (S1). About the data stored in measured data file F1, since the grade of capacity of balance is known, the proper threshold which refers to the data stored in measured data file F1, and serves as a decision criterion of capacity of balance is set up. Then, rocking of the plinth 1 is made to start, where people are embarked into the plinth 1 (S2). The amplitude of a shake of the head which the sensor 5 which mentioned above the grade of the shake of people's head detected, and was detected by the sensor 5 here is compared with the threshold set up at Step S1 for every sampling (S3). When the amplitude of a shake of a head is beyond a threshold, the number of times is calculated and it stores in the count file F2 (S4). Such processing is continued until the program of the drive defined beforehand is completed (S5), and the capacity of balance of the person who got into [ the plinth 1 ] based on the enumerated data stored in the count file F2 after the end of a program is judged (S6). That is, since enumerated data become small, they can evaluate capacity of balance by size of enumerated data objective, so that capacity of balance is high.

[0044] In using stability for the judgment of capacity of balance, it becomes a procedure shown in drawing 15. Since it is necessary to get to know change of the rhythm (that is, pattern of a shake of a head) in an individual to judge stability and the pattern of a shake is evaluated, the Fourier transform of the pattern is carried out for every fixed time, and it asks for amplitude, frequency, and a phase. That is, rocking of the plinth 1 is made to start like drawing 15, where people are embarked into the plinth 1 (S1), and the pattern which evaluated and evaluated the pattern for every sampling in this state is stored in the pattern file F3 (S2). Next, a proper central value is determined based on the numerical value stored in the pattern file F3 (S3). A central value is suitably set as the period which is driving the plinth 1 periodically, and can use the moving average about the value of several kinds of the values stored in the pattern file F3, etc. The calculated central value is stored in the central value file F4. When the pattern obtained in Step S2 is differed from (S4) and a central value as compared with a central value after calculating a central value, the number of times is calculated (S5). Here, proper width is given to the central value, and if the value calculated at Step S2 is in width, it will be judged that it is in agreement with a central value. Such processing is continued until the program of the drive defined beforehand is completed (S6), and the capacity of balance which got into [ the plinth 1 ] based on enumerated data after the end of a program is judged (S7). That is, since change does not arise to the pattern of a shake so that capacity of balance is high, the enumerated data in Step S5 become small, and can evaluate capacity of balance by size of enumerated data objective.

[0045] In using a response for the judgment of capacity of balance, it becomes a procedure shown in drawing 16. That is, about a response, the threshold about the time lag of the shake of a head to the drive of the plinth 1 is determined like the size of a shake based on measured data file F1 which stored the pattern of rocking of the plinth 1, and the pattern of the shake of the head about two or more persons (S1). Since the grade of capacity of balance is known, the data stored in measured data file F1 can determine the threshold which serves as a decision criterion of capacity of balance based on the data stored in measured data file F1. Then, the drive of the plinth 1 is made to start, where people are embarked into the plinth 1 (S2). Here, the time lag of the drive of the plinth 1 and the shake of people's head is searched for for every sampling, and it stores in the time lag file F5 (S3). When (S4) and the time lag searched for exceed the threshold calculated at Step S1 as compared with the threshold which searched for the time lag searched for at Step S1, the number of times is calculated (S5). Such processing is continued until the program of the drive defined beforehand is completed (S6), and the capacity of balance which got into [ the plinth 1 ]

based on enumerated data after the end of a program is judged (S7). That is, since it is thought that a time lag until a head shakes from the drive of the plinth 1 is small so that capacity of balance is high, the enumerated data in Step S5 become small, and can evaluate capacity of balance by size of enumerated data objective.

[0046]Although the size of the shake mentioned above, stability, and a response may be separately used for the judgment of capacity of balance, it may be made to judge capacity of balance synthetically by combining these suitably. However, when combining two or more kinds of decision values, it is required to judge capacity of balance by addition with dignity, etc.

[0047]

[Effect of the Invention]While the invention of Claim 1 gives the stimulus which loses the balance of those who have ridden on the plinth by which swinging and driving is carried out to the timing which is not predicted by people, It is characterized by judging capacity of balance based on the reaction pattern which detected people's reaction to this stimulus, and was detected after giving a stimulus, After losing the grade and balance which lost balance since the stimulus which loses balance to the timing which people do not predict was given, the high level of capacity of balance can be evaluated by detecting time until it returns to the state of maintaining balance etc.

[0048]In the invention of Claim 1, without a stimulus adding a special device by being characterized by being given by changing rocking of a plinth, the invention of Claim 2 only changes the rocking pattern of a plinth suitably, and can give the stimulus for evaluating capacity of balance.

[0049]Set the invention of Claim 3 to the invention of Claim 1. When a stimulus directs operation to people by being characterized by being given by directing operation to people, game nature can be given when judging capacity of balance, and capacity of balance can be judged, enjoying itself.

[0050]In the invention of Claim 1 thru/or Claim 3, the invention of Claim 4 a reaction pattern, The time which has lost balance after giving time until it operates so that balance may be maintained after giving a stimulus, and a stimulus, By being characterized by being at least 1 element of movement magnitude when a stimulus is given, and the time to the grade and reaction of a stimulus, if these information is used, capacity of balance can be evaluated easily.

[0051]The driving means to which the invention of Claim 5 carries out swinging and driving of the plinth on which people ride, and the plinth, The stimulation means which gives the stimulus which loses the balance of those who have ridden on the plinth to the timing which is not predicted by people, It is a thing provided with the sensor which detects people's reaction to this stimulus, and the judging means which judges capacity of balance based on the reaction pattern detected by a sensor after giving the stimulus by a stimulation means, After losing the grade and balance which lost balance since the stimulus which loses balance to the timing which people do not predict was given, the high level of capacity of balance can be evaluated by detecting time until it returns to the state of maintaining balance etc.

[0052]The invention of Claim 6 is what detects a motion of people's desired region from the temporal change of the picture in which the sensor picturized those who the plinth was independently provided in the invention of Claim 5, and have ridden on the plinth by non-contact, Since a sensor is formed apart from a plinth and a sensor detects a motion of people's desired region by non-contact, there is an advantage that a motion of people can be detected without making conscious of a sensor the person who got into [ a plinth ].

[0053]The invention of Claim 7 asks for the period when the amplitude of a motion of the desired region where the judging means was detected by the sensor exceeds a regular threshold in the invention of Claim 6, It judges with capacity of balance being high, so that this period is short, and it becomes possible to evaluate capacity of balance by amplitude of a motion of people quantitatively and objective.

[0054]The invention of Claim 8 extracts the pattern within a short time in the invention of Claim 6 about a motion of the desired region where the judging means was detected by the sensor, It can judge with capacity of balance being high, so that there is little change of a pattern, and based on the pattern of a motion of people, capacity of balance can be evaluated objective.

[0055]The invention of Claim 9 searches for a time lag with a motion of a plinth in the invention of Claim 6 about a motion of the desired region where the judging means was detected by the sensor, It can judge with capacity of balance being high, so that this time lag is small, and capacity of balance can be evaluated based on the time lag of a motion of a plinth and a motion of people, and

it can evaluate objective.

[0056]The invention of Claim 10 judges capacity of balance combining the plurality of the judging means used for the capacity-of-balance determining device according to any one of claims 7 to 9, it is using two or more kinds of criteria, and the more exact evaluation about capacity of balance is attained.

[0057]In the invention of Claim 5, without a stimulation means's giving the directions to which rocking of a plinth is changed to a driving means, and adding a special device, the invention of Claim 11 only changes the rocking pattern of a plinth suitably, and can give the stimulus for evaluating capacity of balance.

[0058]By a stimulation means's being the display device formed independently in the invention of Claim 5, and the invention of Claim 12 displaying directions of operation into the image displayed on a display device, and directing operation to people, Game nature can be given when judging capacity of balance, and capacity of balance can be judged, enjoying itself.

[0059]In the invention of Claim 5, a plinth is provided with the grip part which people have by hand, and the invention of Claim 13 can evaluate capacity of balance easily, if a sensor detects at least 1 element of power when holding a grip part, the power which pushes and lengthens a grip part, and people's centroid position and uses these information.

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[Translation done.]

\* NOTICES \*

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1.This document has been translated by computer. So the translation may not reflect the original precisely.

2.\*\*\*\* shows the word which can not be translated.

3.In the drawings, any words are not translated.

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## DESCRIPTION OF DRAWNGS

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### [Brief Description of the Drawings]

[Drawing 1]It is a block diagram showing Embodiment 1 of this invention.

[Drawing 2]It is a perspective view showing an entire configuration same as the above.

[Drawing 3]It is a perspective view showing the drive used for the same as the above.

[Drawing 4]It is a figure showing the control information used for the same as the above.

[Drawing 5]It is a figure showing a measurement procedure same as the above.

[Drawing 6]It is an explanatory view of operation same as the above.

[Drawing 7]It is an explanatory view of operation same as the above.

[Drawing 8]It is a block diagram showing Embodiment 2 of this invention.

[Drawing 9]It is a figure showing a measurement procedure same as the above.

[Drawing 10]Embodiment 3 of this invention is shown, (a) is an important section top view and (b) is an important section side view.

[Drawing 11]It is a figure showing the measurement result by the sensor used for the same as the above.

[Drawing 12]It is a figure showing the measurement result by the sensor used for the same as the above.

[Drawing 13]It is a figure showing the measurement result by the sensor used for the same as the above.

[Drawing 14]It is an explanatory view of operation same as the above.

[Drawing 15]It is an explanatory view of operation same as the above.

[Drawing 16]It is an explanatory view of operation same as the above.

### [Description of Notations]

1 Plinth

2 Drive

4 Handle

5 Sensor

6 Display device

32a Basic data storage parts store

32b Stimulus data storage part

34 Pattern detection part

35 Evaluating part

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[Translation done.]



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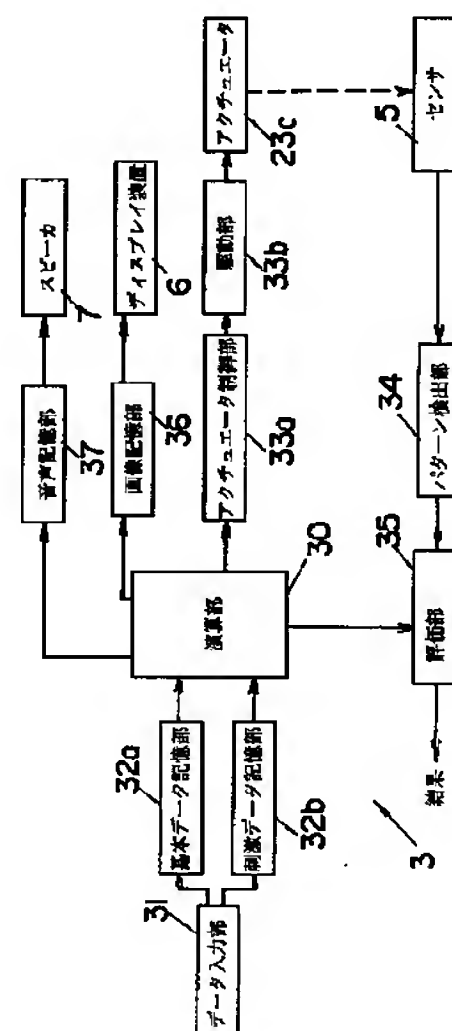
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(54) 【発明の名称】 バランス能力判定方法およびその装置

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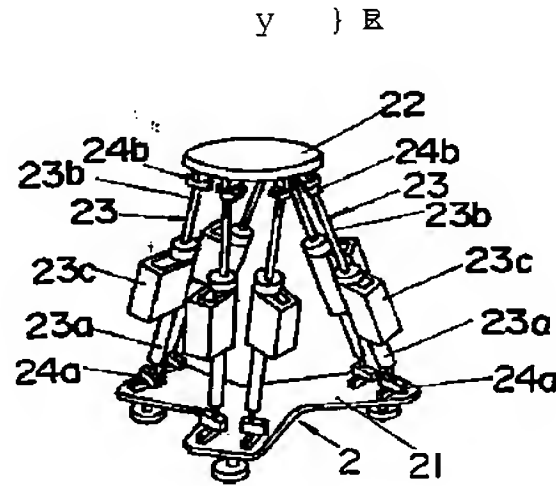
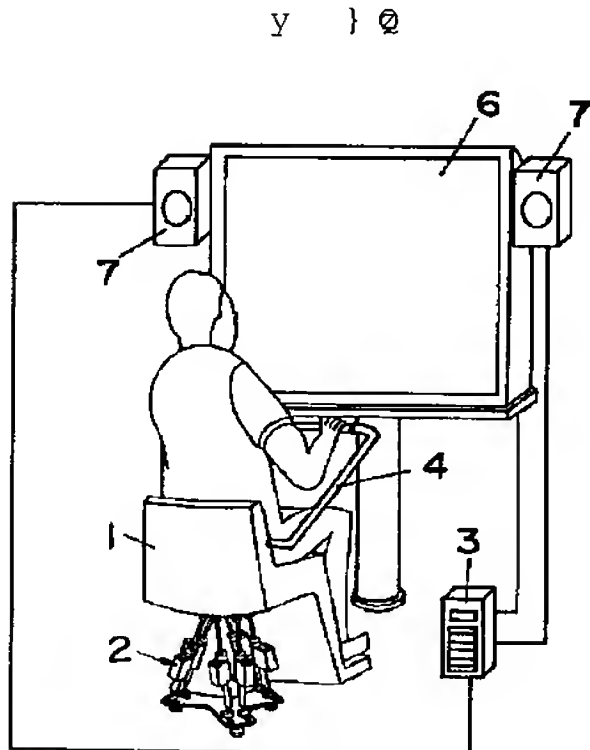
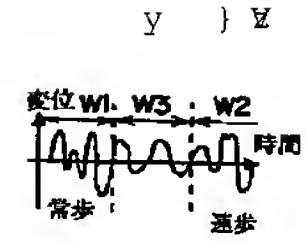
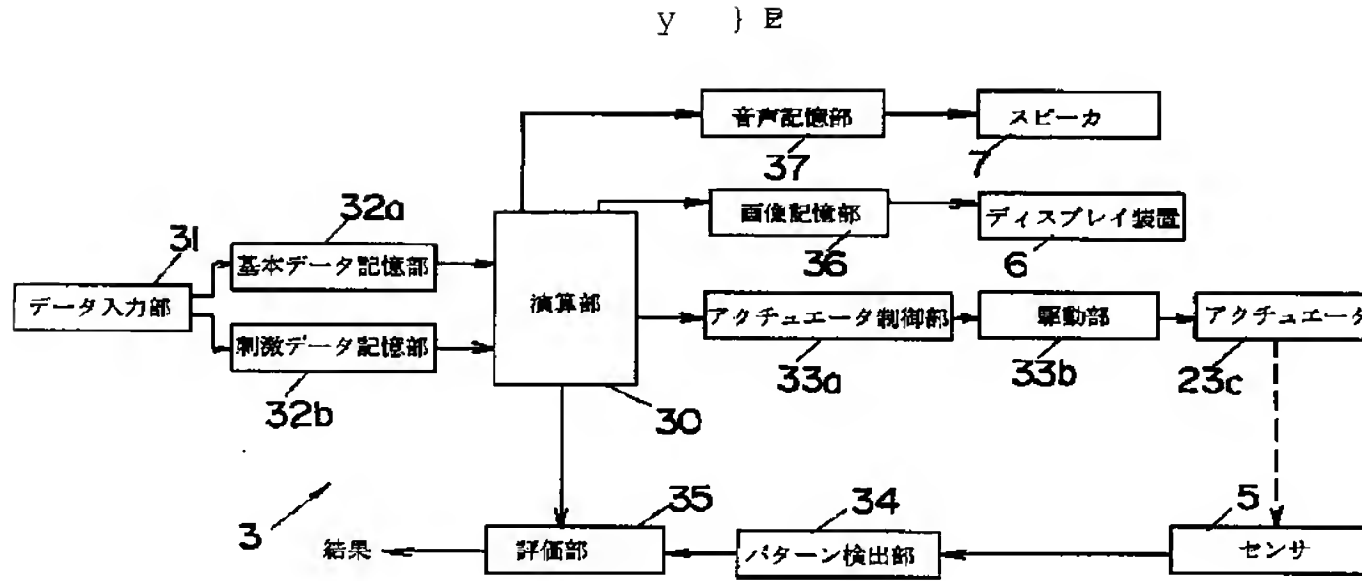


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T2	X2	Y2	Z2	$\alpha 2$	$\beta 2$	$\gamma 2$
T3	X3	Y3	Z3	$\alpha 3$	$\beta 3$	$\gamma 3$
...	...	...	...	...	...	...
T11	X01	Y01	Z01	$\alpha 01$	$\beta 01$	$\gamma 01$
T12	X02	Y02	Z02	$\alpha 02$	$\beta 02$	$\gamma 02$
...	...	...	...	...	...	...
T1n	X0n	Y0n	Z0n	$\alpha 0n$	$\beta 0n$	$\gamma 0n$
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Tm	Xm	Ym	Zm	$\alpha m$	$\beta m$	$\gamma m$

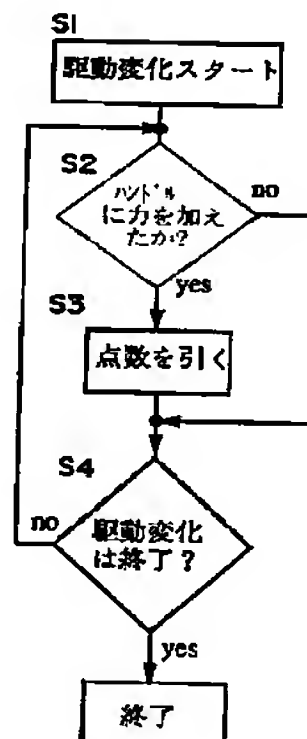
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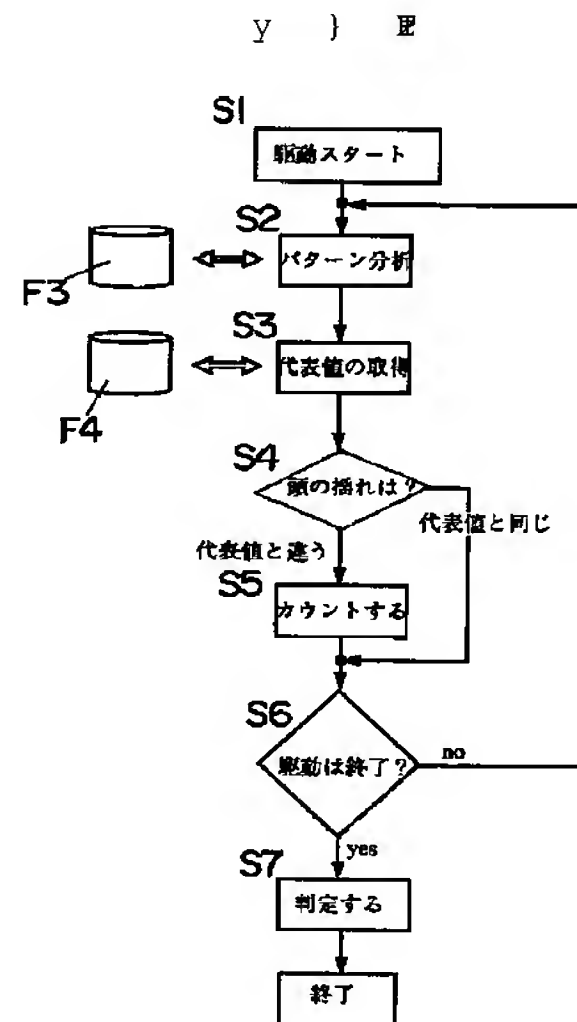
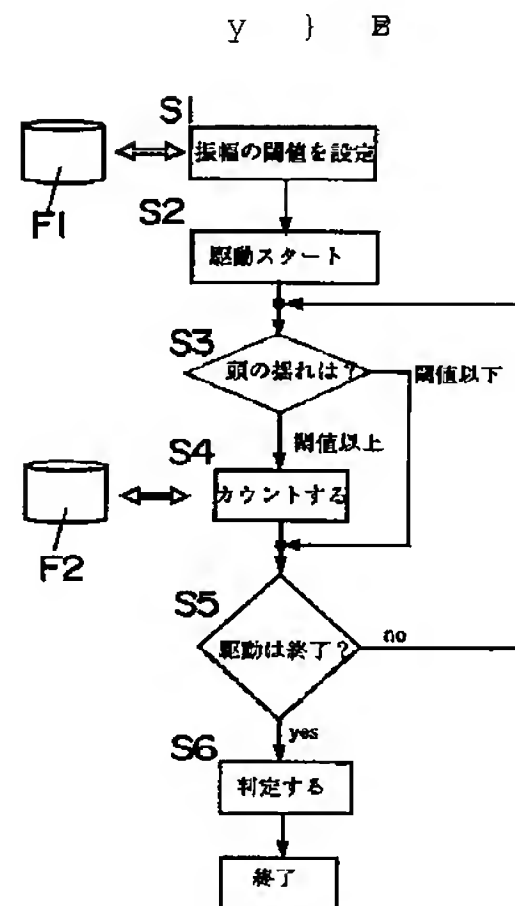
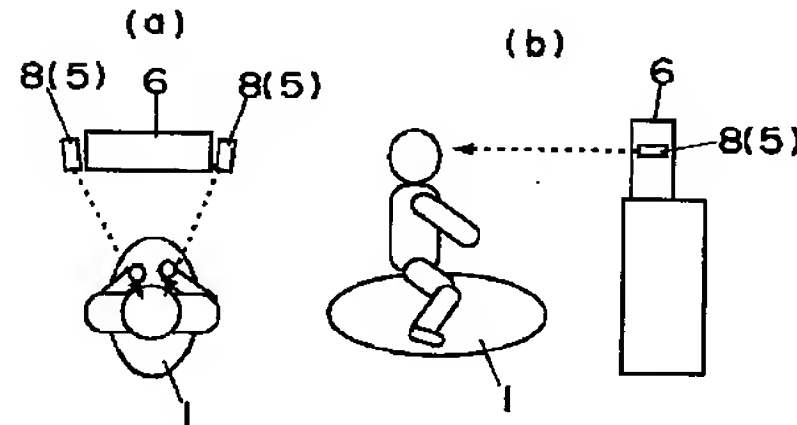
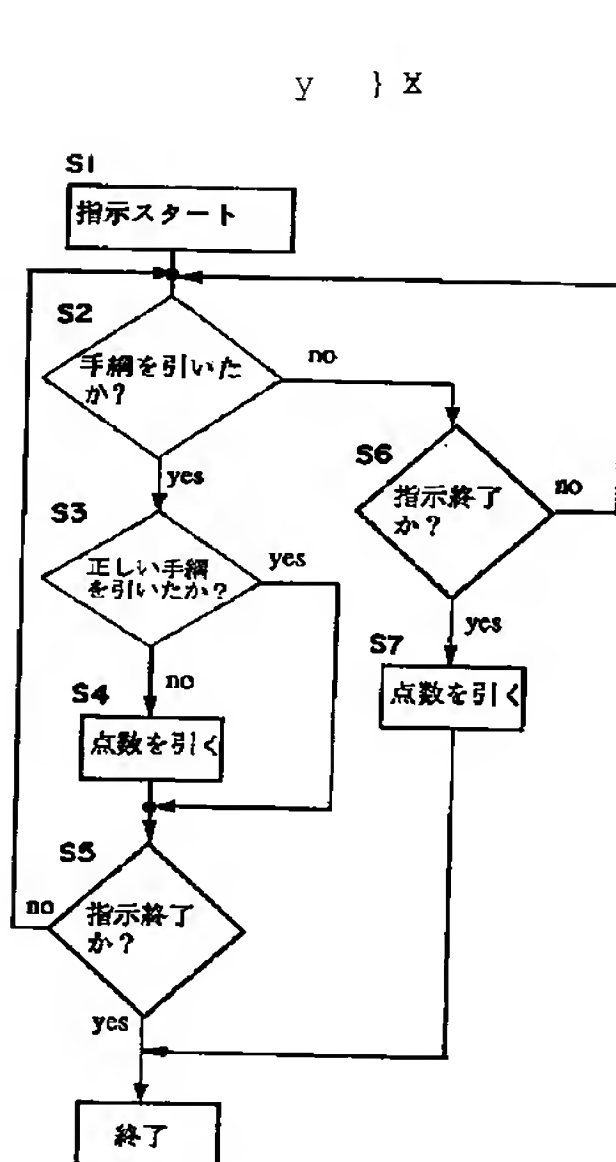
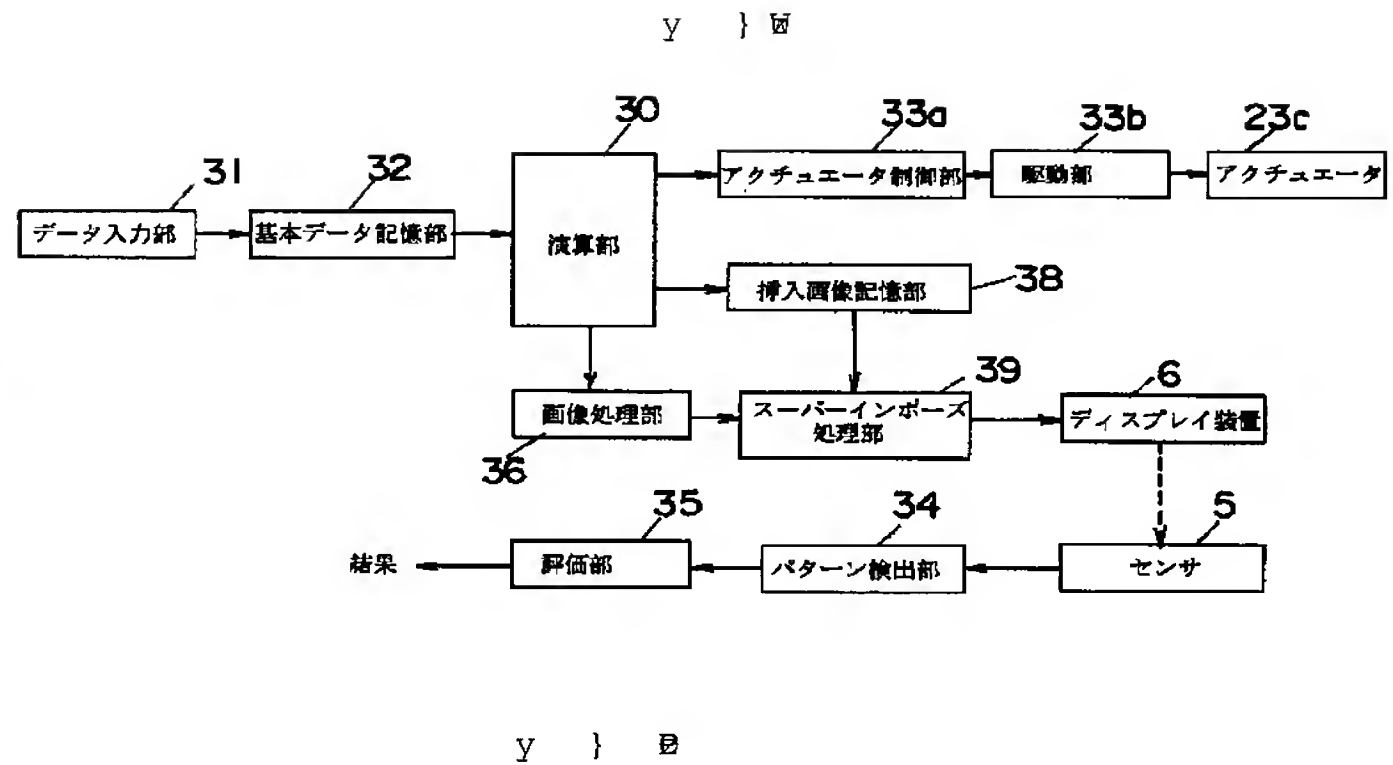
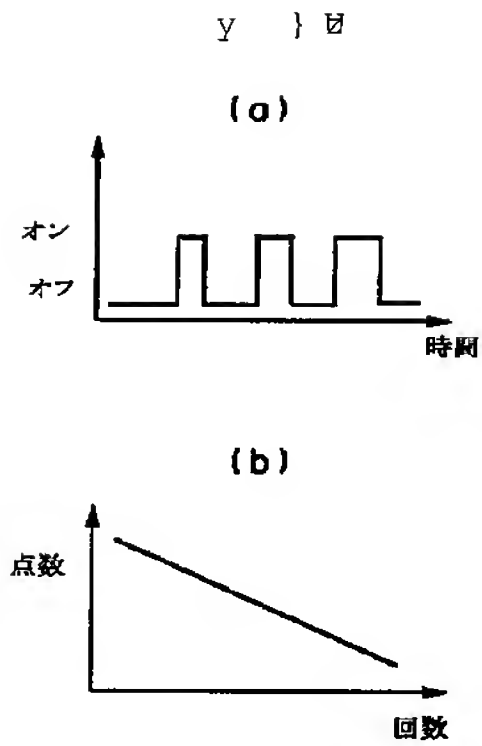
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T12	X12	Y12	Z12	$\alpha 12$	$\beta 12$	$\gamma 12$
T13	X13	Y13	Z13	$\alpha 13$	$\beta 13$	$\gamma 13$
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T1n	X1n	Y1n	Z1n	$\alpha 1n$	$\beta 1n$	$\gamma 1n$

(c)

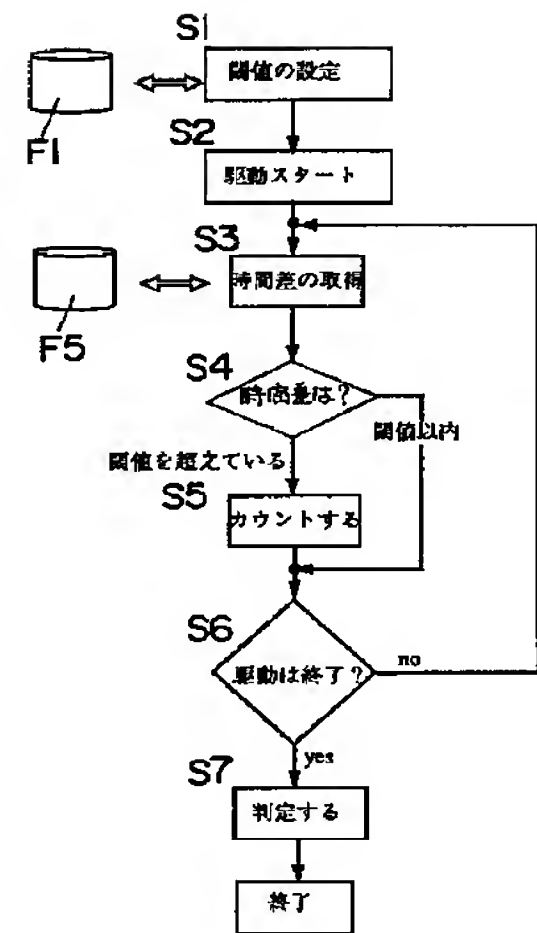
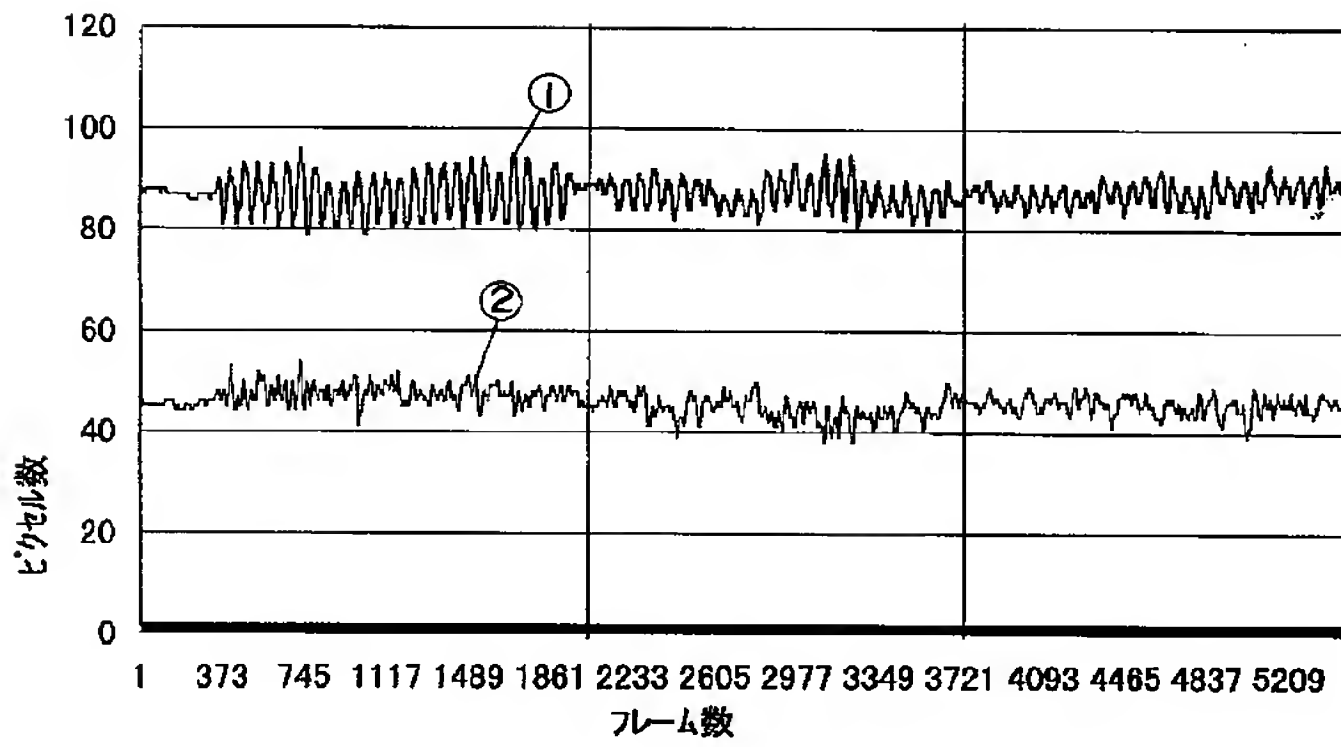
時間	X	Y	Z	$\alpha$	$\beta$	$\gamma$
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T3	X3	Y3	Z3	$\alpha 3$	$\beta 3$	$\gamma 3$
...	...	...	...	...	...	...
T11	X21	Y21	Z21	$\alpha 21$	$\beta 21$	$\gamma 21$
T12	X22	Y22	Z22	$\alpha 22$	$\beta 22$	$\gamma 22$
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T1n	X2n	Y2n	Z2n	$\alpha 2n$	$\beta 2n$	$\gamma 2n$
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Tm	Xm	Ym	Zm	$\alpha m$	$\beta m$	$\gamma m$



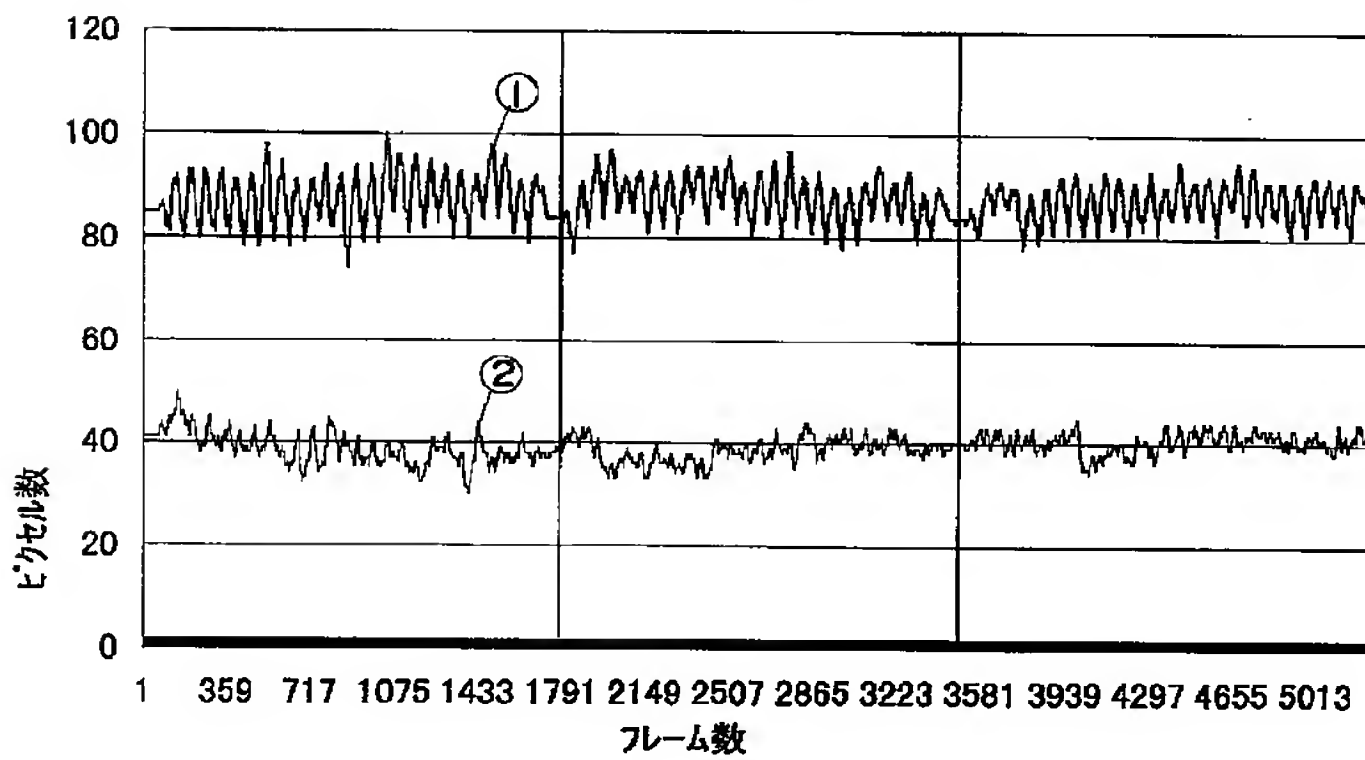




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